Various Implementations of Groundwater Irrigation: Challenges and Recommendations of Including it as a Forcing in CMIP7

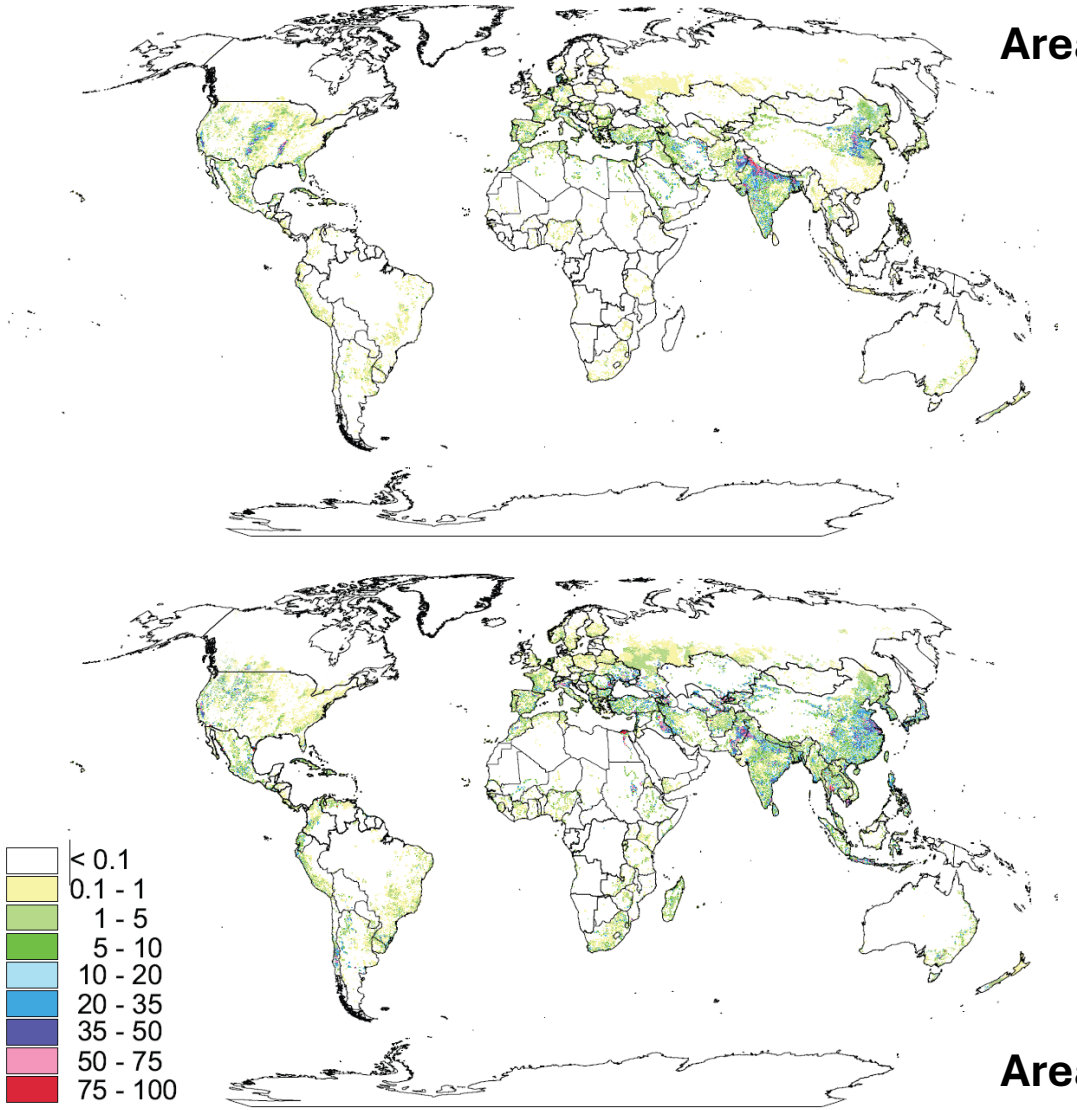
Yi Yao, ETH Zurich, VUB

IRRMIP

ETH zürich

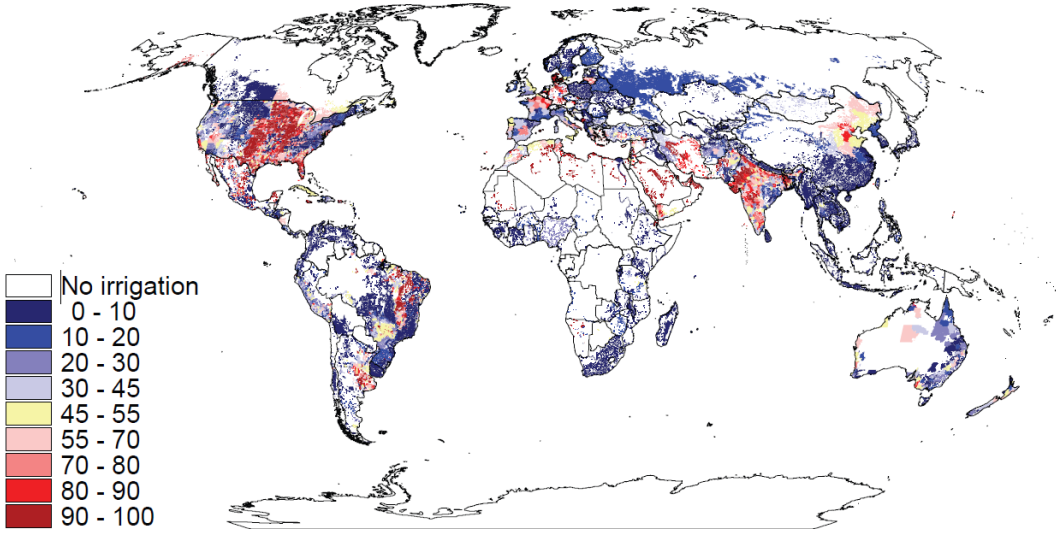
VUB VRIJE UNIVERSITEIT BRUSSEL

Current dataset of groundwater for irrigation



Area equipped for groundwater irrigation

Percentage of groundwater irrigation



Area equipped for surface water irrigation

Siebert, S., Burke, J., Faures, J. M., Frenken, K., Hoogeveen, J., Döll, P., & Portmann, F. T. (2010). Groundwater use for irrigation–a global inventory. Hydrology and earth system sciences, 14(10), 1863-1880.

Irrigation representations in ESMs

IRRMIP

Soil moisture-based

CESM2 ⇒ Demand cannot be met by solely surface water

IPSL-CM6 ⇒

E3SMv2 ⇒

NorESM

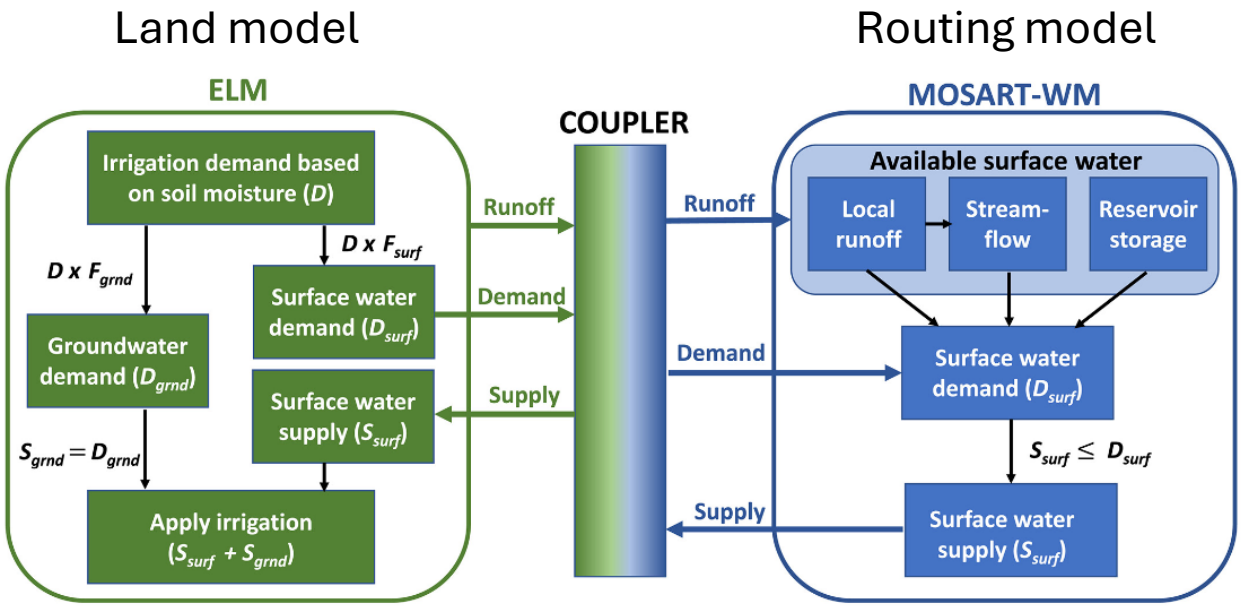
External parameters

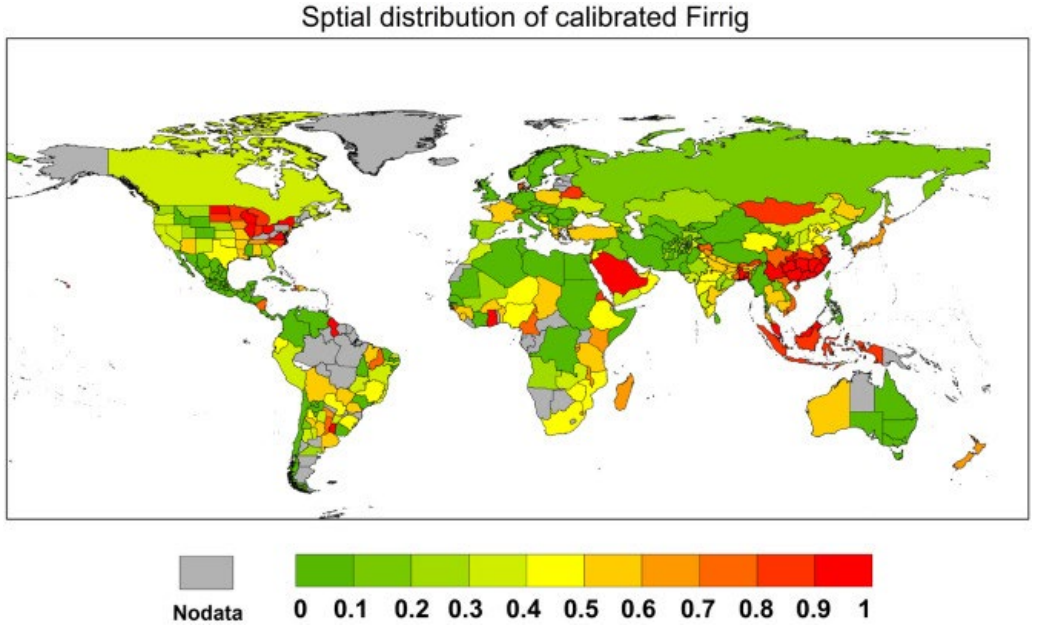
External forcing

NASA-GISS

CNRM-CM6 ⇒

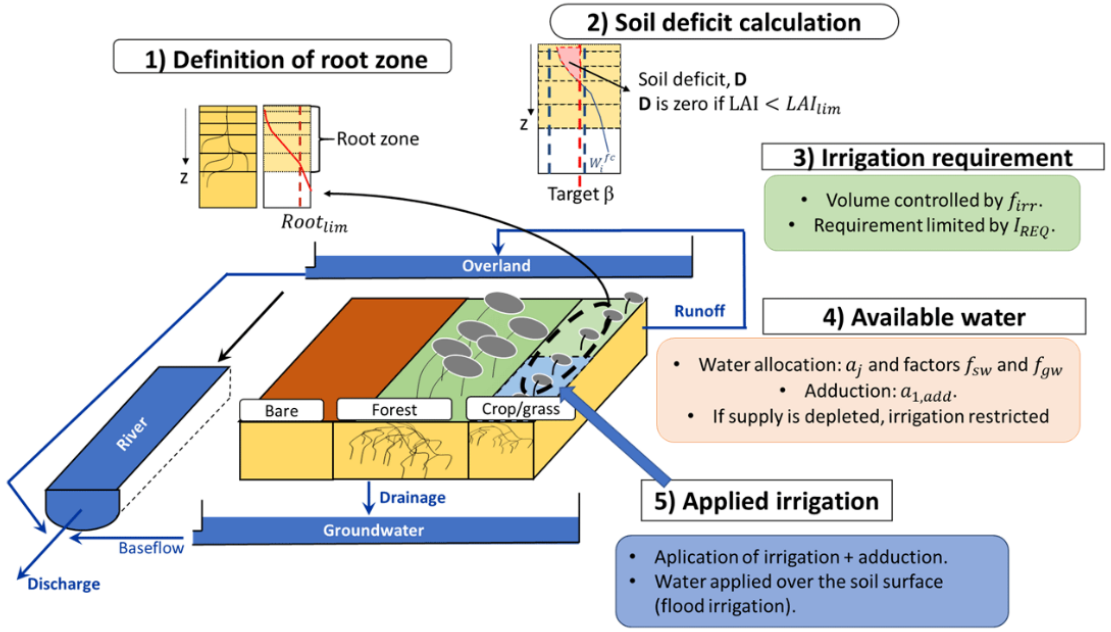
Groundwater irrigation representations in E3SM



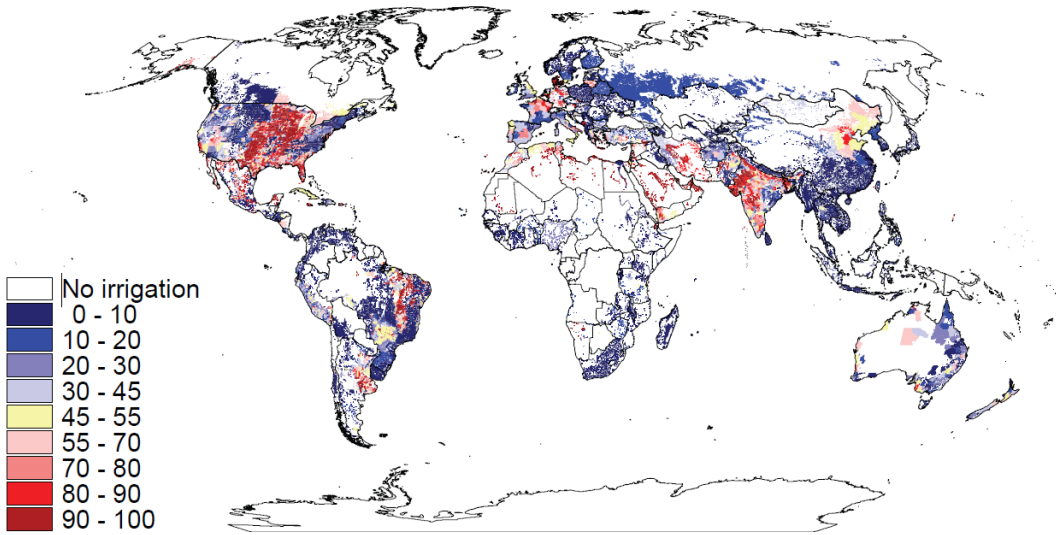


Leng, G., Huang, M., Tang, Q., & Leung, L. R. (2015). A modeling study of irrigation effects on global surface water and groundwater resources under a changing climate. Journal of Advances in Modeling Earth Systems, 7(3), 1285-1304.

Groundwater irrigation representations in IPSL-CM6

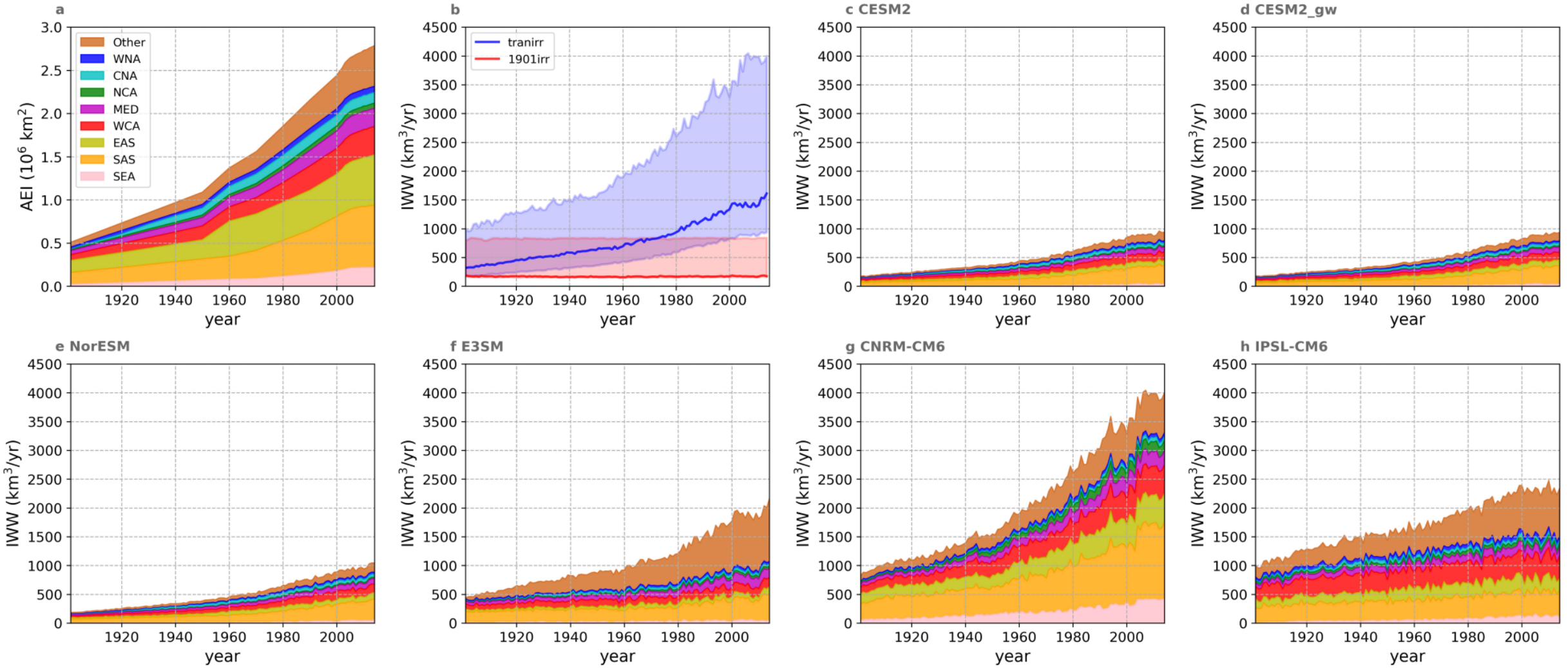


Percentage of groundwater irrigation



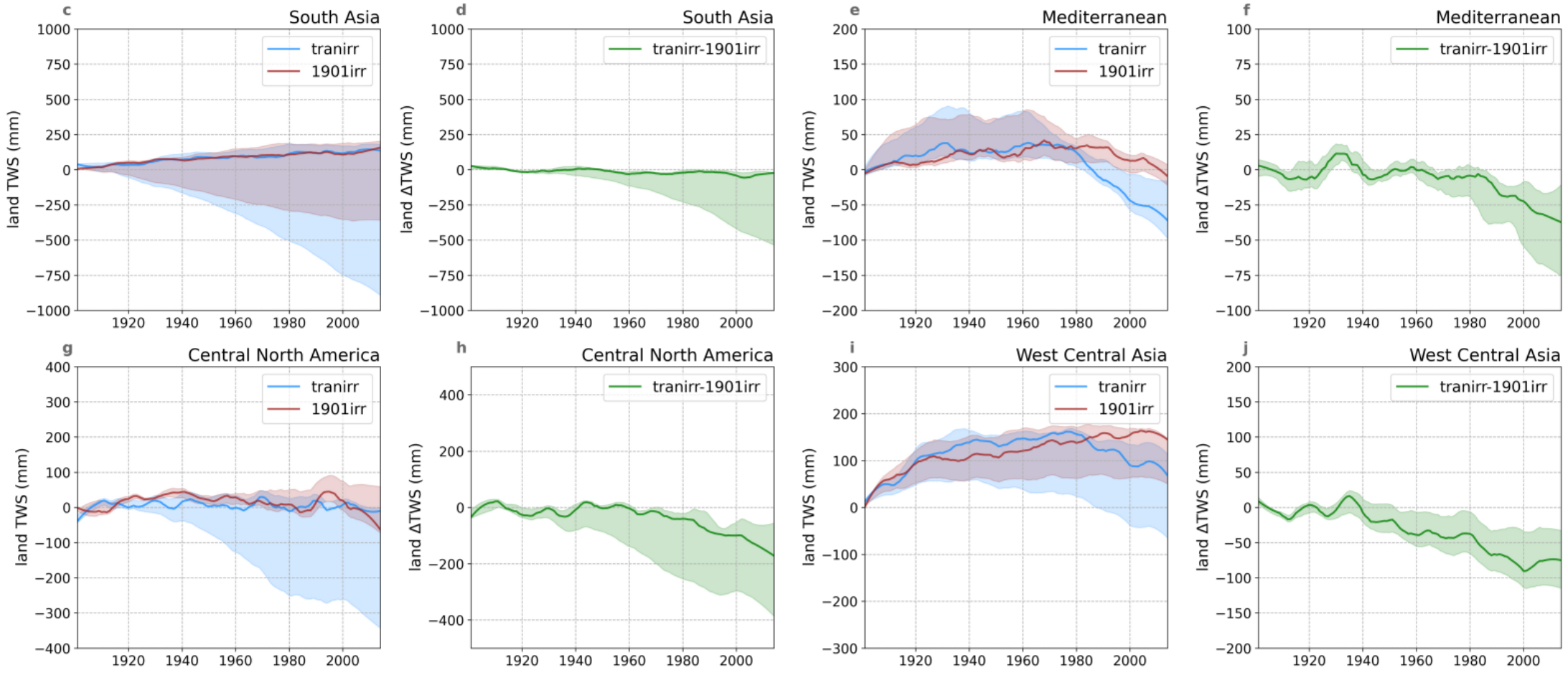
Arboleda-Obando, P. F., Ducharne, A., Yin, Z., & Ciais, P. (2024). Validation of a new global irrigation scheme in the land surface model ORCHIDEE v2. 2. Geoscientific Model Development, 17(5), 2141-2164.

Uncertainties in simulated water withdrawal



Uncertainties in simulated TWS

ESMs: IPSL-CM6, CNRM-CM6, and CESM2_gw



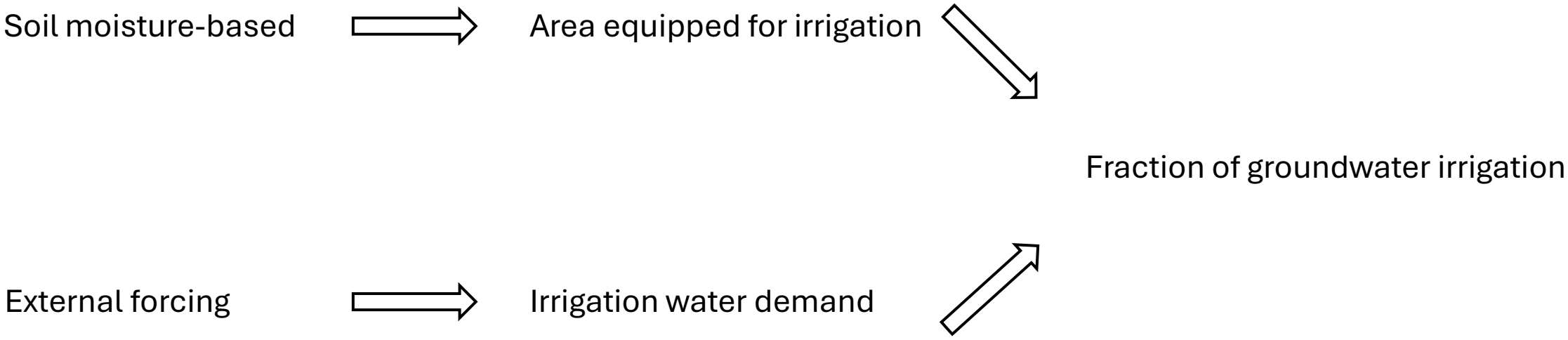
Challenges to include groundwater for irrigation as a forcing

Challenge 1: various implementations of irrigation and groundwater withdrawal

Challenge 2: lack of projected information of groundwater irrigation

Suggestions to include groundwater for irrigation as a forcing

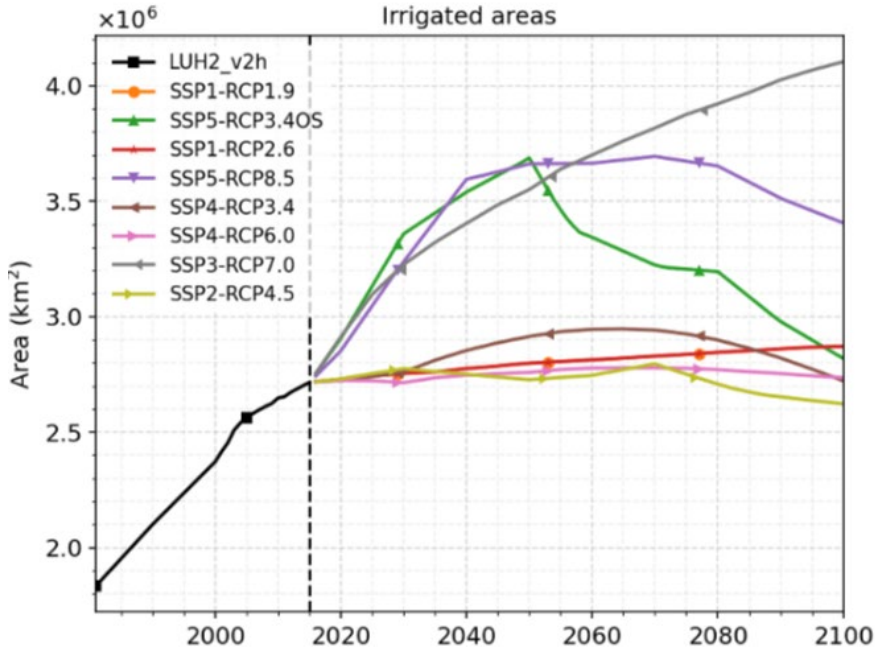
Challenge 1: various implementations of irrigation and groundwater withdrawal



Suggestion 1: using the land module of each ESM to calibrate the parameters to get similar water withdrawal.

Suggestions to include groundwater for irrigation as a forcing

Challenge 2: lack of projected information of groundwater irrigation



Suggestion 2: keep the parameters fixedusing one land model considering water availability to project related parameters.

Hurtt, G. C., Chini, L., Sahajpal, R., Frolking, S., Bodirsky, B. L., Calvin, K., ... & Zhang, X. (2020). Harmonization of global land-use change and management for the period 850–2100 (LUH2) for CMIP6. Geoscientific Model Development Discussions, 2020, 1-65.

THANKS!